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23 JUN 1961

Please Return To
Engineering Staff

Director of Logistics

Director of Communications

Initiation of Task Order 4 - Contract 616

1. The Office of Communications has a requirement for an Accessory Unit, AU-3 to enhance agent communication radio reception. [redacted], Philadelphia, Pennsylvania, has submitted a cost estimate and technical proposal for the development of such a device. 25X1

2. [redacted] proposal, a copy of which is attached, has been carefully examined by this Office and is considered technically acceptable. 25X1

3. It is requested therefore that Task Order 2 under Contract 616 be initiated with [redacted] 25X1
[redacted], according to the contractor's proposal. At- 25X1
tached for this purpose is Requisition No. MSB 61-343 indicating that the allotment to be charged is 1179-0010-1000. Funds in the amount of $4,318.72 have been encumbered for this purpose. The association of this equipment and the contract with the Agency is classified SECRET, although the equipment itself is UNCLASSIFIED. The cognizant project engineer for this program i[redacted] 25X1

[redacted] 25X1

Attachments:
1) Contractor's proposal dated June 1961
2) Requisition No. MSB 61-343

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AUTOMATIC GAIN REGULATION SYSTEM

FOR AUDIO AMPLIFIERS

June 1961

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25X1

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[redacted], is pleased to offer the services described in the following proposal. 25X1

Prepared by

[redacted] 25X1

Section Head, Equipments Division

Approved by

[redacted] 25X1

Vice-President

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Technical Proposal 61-54

AUTOMATIC GAIN REGULATION SYSTEM
FOR AUDIO AMPLIFIERS

I. INTRODUCTION

This proposal describes a program for the development and design of a new and unique system for the automatic regulation of audio output to maintain a level for intelligible reception in the presence of widely varying ambient noise conditions, while at the same time not allowing excessive volume under quiet conditions.

The Automatic Gain Regulation System for Audio Amplifiers, subsequently referred to as the AGR System, is intended for use with radio receivers or other devices having an audio output up to approximately 1 mw. [redacted] 25X1 is currently doing work on a similar problem of automatic gain regulation at higher power levels with different requirements under Contract No. 616 Task Order No. 3.

II. APPROACH

A. Objective

This program will have as its objective the development and design of a miniature device which will regulate the output from a radio receiver or other equipment whose output may be up to 1 mw, providing automatic gain regulation based on ambient noise in such a way that the available audio output will be adequate under high noise conditions and will not be excessive when the ambient noise is at a low level. Inlcuded in the objective are the following specifications:

1. Power Input, up to 1 mw.

2. Maximum Power Output, 100 microwatts into a 2,000 ohm load.

3. Output in the absence of Noise, 1 to 2 microwatts, with a maximum automatic gain regulation of 17 to 20 db, providing an automatic control of at least 2 to 100 microwatts under noise conditions varying from 0 to maximum.

4. Intelligibility. The Automatic Gain Regulation System will not appreciably alter Intelligibility for signal levels which would normally be understandable.

5. Size. The unit will have a volume of approximately one-half to one cubic inches and will have a flat form factor.

6. Power Source. Operating power of the Automatic Gain Regulation Device shall be derived from a small nickel cadmium storage cell which shall receive charging energy by rectification of the audio input to this device.

B. Present State Of The Art

Volume Compressors and Limiters have been developed using vacuum tubes and transistors, but operate at higher power levels and require more power supply energy than would be suitable for the proposed application.

C. Design Considerations

1. System

The system for the Automatic Gain Regulation Device is depicted in Figure 1 in the form of a block diagram. The Audio Source 1, delivering 1 mw maximum power from a 2,000 ohm impedance, drives a pre-attenuator 3. The output of this attenuator is fed to a voltage controlled attenuator 7 and in turn drives the output 8 which feeds a 2,000 ohm load and supplies up to 100 microwatts of power. The input audio signal is also fed to a solid state rectifier and supply 2. It is anticipated that this supply will be used to maintain the charge on a nickel cadmium storage cell. A noise sensing microphone 4, feeds a high gain noise amplifier 5 whose output is rectified by a noise rectifier 6 and filtered to provide the AGR voltage which is applied to the voltage controlled attenuator 7.

Miniature transistors, diodes and miniature components will be used to achieve the size and power efficiency requirements in this device.

2. Theoretical Considerations

a. Signal Level Requirements

Tests have been conducted which established that audio power levels above 50 microwatts may be heard by an individual who is not using the equipment under low ambient noise conditions. Tests also show that an efficient headphone may require as low as 1 to 5 microwatts for audibility under low ambient noise conditions. Conversely, high noise conditions may require as much as 50 or more microwatts to allow intelligible reception. Therefore, the proposed automatic gain regulation will provide approximately 17 to 20 db of audio output control.

b. Methods of Gain Regulation

The voltage controlled attenuator, Item 7 of Figure 1, may be in the form of a variable series or shunt impedance. Methods of varying this impedance include the use of transistors and diodes. In the case of the diode, these may be applied in the form of "L" or "TEE" Attenuators. One of the problems associated with this type of device are the nonlinear characteristics for varying signal levels. In the case of the diode attenuator arrangement, use of a low level audio signal and operation on a lower part of the curve can produce linear operation with minimum distortion. The pre-attenuator 3, will be used to establish the proper input level to the voltage controlled attenuator.

c. Noise and AGR Circuit

A miniature noise sensing microphone 4, will be used to sense the ambient noise level. This microphone will be a flat miniature type and may be mounted on the front of the Automatic Gain Regulation Unit, thus forming a part of the housing. The high gain noise amplifier 5, may use as many as three (3) miniature transistors with an overall gain of approximately 70 db. The output of the noise amplifier will be rectified and filtered with the proper time constants to produce the DC voltage which will be applied to the voltage controlled attenuator 7. The output filter of the noise rectifier will have a short charging time constant so that it will respond quickly to an increased noise level to avoid missing the first part of a word. The proper discharge time constant will be determined by experiment, but is expected to be between 2/10 and 1/2 second.

3. Power Supply

The power supply which is proposed, will be a small nickel-cadmium storage cell having a potential of approximately 1.3 volts. A rectifier 2, shown in Figure 1 will derive power from the 1 mw audio source and this will be used to charge on the storage cell. Although we will investigate the use of rectified power from the signal source without a storage cell, this method probably will not maintain adequate power supply to have the noise amplifier operating properly at all times. Furthermore, the first part of a transmission under high noise conditions may be lost since it is necessary to build up a power supply voltage before the voltage controlled attenuator would open up to allow high audio.

III. WORK STATEMENT

A. Work To Be Performed

1. Development and Breadboarding, Phase I.

2. Design & Construction of a Prototype, Phase II.

B. Items To Be Delivered

1. One Laboratory Prototype in accordance with [redacted] Proposal 61-54. 25X1

2. One report, three (3) copies at the end of Phase I.

3. One final report, three (3) copies.

4. Operating Instructions Manual, including schematics and diagrams of the Automatic Gain Regulation System.

IV. SUMMARY AND CONCLUSION

A program has been described for the development, design and construction of a miniature device which may be connected between a radio receiver and a load or headphone to accomplish automatic regulation of volume level as referenced to ambient noise. This device will reduce the volume to a safe level at low ambient noise and will increase the volume in proportion to increased ambient noise to maintain intelligible reception at all times.

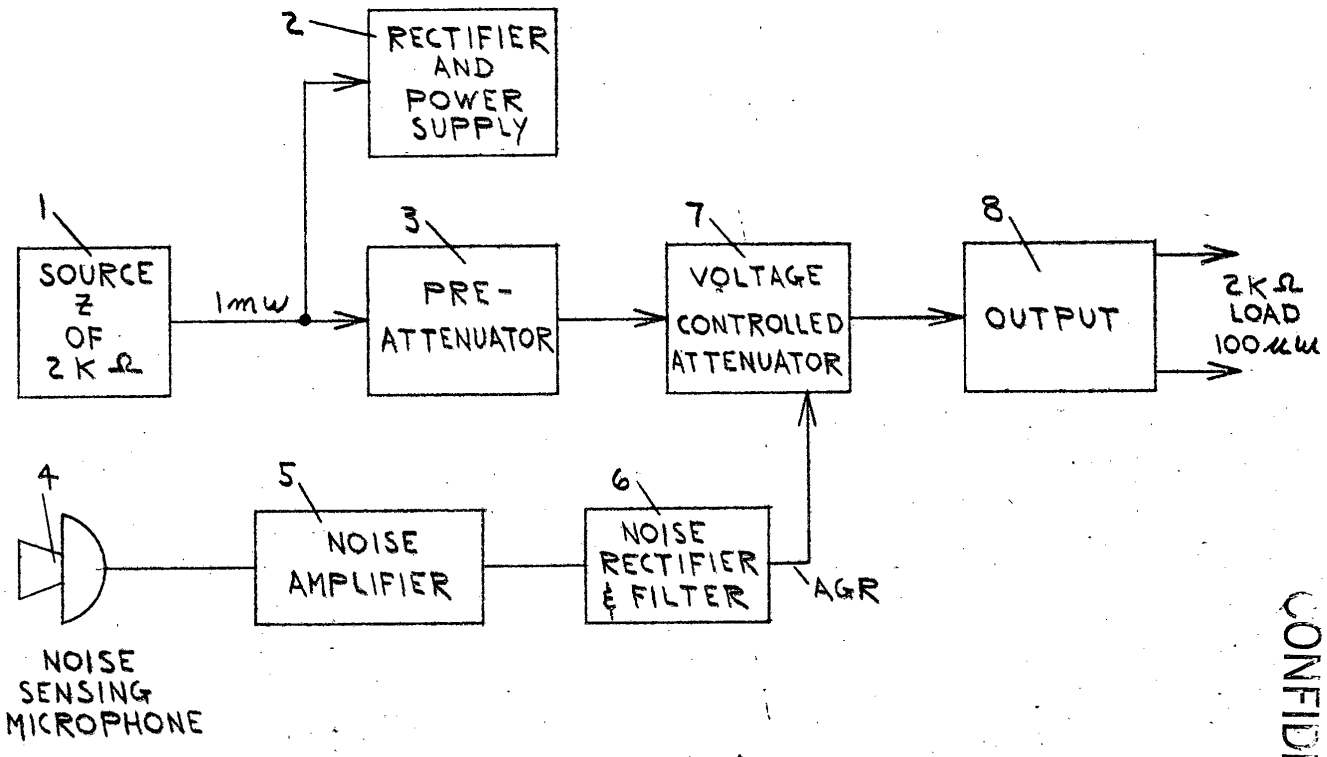

FIGURE 1

BLOCK DIAGRAM OF THE AUTOMATIC GAIN REGULATION SYSTEM.